# Appendix III - San Benito Mountain Research Natural Area Management Plan

The San Benito Mountain Research Natural Area (SBMRNA), located within the Clear Creek Management Area (CCMA), was designated by the BLM in 1999 to encourage research and provide protection of the unique conifer forest and vegetation communities on and around San Benito Mountain (BLM 1999). The boundaries of the existing SBMRNA were subsequently expanded as identified in the Clear Creek Management Area Resource Management Plan Amendment and Route Designation Record of Decision (BLM 2006). This Research Natural Area Management Plan guides management of the SBMRNA and identifies management goals and objectives that will permit natural processes to continue without interference.

## *1.1 Introduction*

The Bureau of Land Management establishes and maintains Research Natural Areas (RNAs) for the primary purpose of research and education. RNAs have one or more of the following characteristics (43 CFR 8223 – Research Natural Areas):

- A typical representation of a common plant or animal association;
- An unusual representation of a common plant or animal association;
- A threatened or endangered plant or animal species;
- A typical representation of common geologic, soil, or water features;
- Outstanding or unusual geologic, soil, or water features.

Dr. James R. Griffin made the original recommendation to establish the San Benito Mountain Natural Area in 1970, declaring that "…it would in no way duplicate any North Coast Range serpentine natural area and would be a highly desirable contrast with them." The San Benito Mountain Research Natural Area (SBMRNA) has outstanding features including geology, soils, ecology, and threatened plant species.

Ultramafic areas are distributed throughout California, primarily in the Sierra Nevada, Klamath Mountains, and Coast Ranges. Ultramafic rock (henceforth referred to as "serpentine") is an igneous rock with very low silica content (less than 45%), generally >18% magnesium oxide, high iron oxide, low potassium, and composed of usually greater than 90% mafic minerals (dark colored, high magnesium and iron content) (Brooks 1987; Alexander et al. 2007). Ultramafic rock types include peridotite and serpentinite (hydrothermally altered). The New Idria serpentine mass (synonymous with the BLM designation "Serpentine ACEC") is outstanding as a geologic feature among the serpentine areas of California. It is the largest serpentine area in the South Coast Range at approximately 30,000 acres in size. The New Idria serpentine mass was formed from peridotite (harzburgite or dunite) which has been completely mineralogically-altered, sheared, and crushed to yield a nearly incoherent mass of serpentinite (Coleman 1957, 1986, 1996; Mumpton and Thompson 1975; Van Baalen 1995). Metamorphism within the New Idria serpentine mass has generated several rare serpentinite-associated minerals which the area is globally famous for, including fresnoite, joaquinite, neptunite, and benitoite (Louderback 1907, 1909, Bradley 1909; Pabst 1951; Coleman 1957, 1986; Laird and Albee 1972). The New Idria serpentine mass also contains many economically-important minerals including cinnabar

(mercury sulfide), chromite (iron-chromium oxide), and chrysotile asbestos, which have all been commercially mined during the past 150 years (Coleman 1957, 1986, 1996; Eckel and Meyers 1946; Matthews 1961; Merritt 1962). Cinnabar was extensively mined adjacent to the SBMRNA (Aurora Mine; San Carlos peak mine pit) when New Idria was active. Due to its unique geology and mineral suites, the New Idria serpentine mass is a popular mineral collection locality and geological research study site.

The extremely sheared and pulverized serpentinite bedrock of the New Idria serpentine mass weathers to produce soils with adverse chemistry including nutrient deficiency (nitrogen, phosphorus, potassium, calcium) and heavy metal toxicity (magnesium, nickel) (Kruckeberg 1984; Alexander et al. 2007; Arroues 2006; Reinsch and Arroues 2010). The pulverized nature of the bedrock, in combination with the extreme adverse soil conditions have resulted in large areas of natural, moonscape barrens completely devoid of vegetation. Areas with greater stability and more soil development support unique vegetation types including serpentine willow/riparian, serpentine chaparral, and mixed conifer forest. The San Benito Mountain mixed conifer forest is the only forest in the world that includes Jeffrey (*Pinus jeffreyi*), Coulter (*Pinus coulteri*), and foothill (*Pinus sabiniana*) pines, and incense cedar (*Calocedrus decurrens*) at the same location (Griffin 1974). The presence of Jeffrey and Coulter pines in such close proximity has resulted in Jeffrey x Coulter pine hybrids (Zobel 1951a, 1951b; Libby 1958; Griffin 1974; Ledig 2000). The area comprising the SBMRNA was clear cut when New Idria was active to supply mine support timbers (particularly incense cedar) and cord wood to fuel the retorts at New Idria (Sloane 1914; Griffin 1974). Very few old growth trees remain in the SBMRNA. Chaparral was also extensively cut to supply cord wood for the retorts. Most of the vegetation has since recovered and represents secondary forest (Griffin 1974).

## *1.2 Planning*

### 1.2.1 Management Goals

The following management goals will contribute to preserving the values for which the SBMRNA was established:

- To protect the globally unique San Benito Mountain mixed conifer forest ecosystem, special status species, and the adjacent ecotones in their natural state for science research and educational purposes. The San Benito Mountain mixed conifer forest contains conifer tree species that occurs nowhere else together in the world (Griffin 1974; Evans et al. 2006). This forest also contains many serpentine endemic herb and shrub species.

- To define and create an environment for research designed (1) to investigate and better understand the geology, biology, ecology, and archaeology, and (2) to build an information base for guiding management of this and other serpentine ecosystems on BLM lands.

- To allow uses inside the SBMRNA compatible with the primary purpose of the Research Natural Area for scientific research and education.

### 1.2.2 Management Objectives

Management objectives result in actions that the BLM and the public evaluate as measures of success in attaining the management goals. Because new information will become a part of adaptive management of the SBMRNA and nearby ecosystems, the management objectives may evolve over to time to meet legal requirements and public expectations.

The following list includes management objectives that will contribute to permitting natural processes to continue within the SBMRNA:

- Include and maintain within management constraints, the core area of the San Benito Mountain forest and a buffer with the transitional chaparral/woodland habitats that border the Forest for the purpose of conservation.

- Establish SBMRNA boundaries on the basis of watershed or other natural features. The BLM policy for its Research Natural Areas is to "Permit natural processes to continue without interference." and to "Determine the boundaries for all vegetation series representatives. In order to preserve the greatest diversity possible, the boundaries will include a variety of elevation, slope, and aspect features, and should follow natural boundaries."

- Protect known suboccurrences and potential habitat of San Benito evening primrose and provide conditions within the SBMRNA in support of the Recovery Plan that conforms to the Biological Opinion for the San Benito evening primrose issued by the U.S. Fish and Wildlife Service (FWS 2005).

- Protect existing suboccurrences and habitat of all other known BLM sensitive species that occur within the SBMRNA boundaries.

- Protect all cultural resources and encourage public partnerships for research and educational use of the SBMRNA.

- Consult with Native Americans from local tribes for management consistent with traditional Native American culture and for full tribal participation in planning, research and environmental education.

- Facilitate quality research overseen by a knowledgeable committee selected from: universities and colleges; other private research institutions; the Native American community; federal and State of California government research and regulatory agencies; and public interest groups and advisory committees. The committee will identify research needs and guide proposed research. Establishment and function of the committee shall meet the provisions established by the Federal Advisory Committee Act (FACA).

- Foster other uses of the SBMRNA that are compatible with its primary purpose. Provide for continued authorized uses such as rights-of-way and easements that are compatible with management values for the SBMRNA.

- Implement the CCMA Resource Management Plan and Record of Decision as they specifically apply to the SBMRNA for the protection and improvement of soil, air, water, and biological resources.

- Develop a Fire Management Plan for the SBMRNA so that the FMO is aware of the sensitive species habitat locations and vehicle access routes.

- Develop a barren area monitoring and restoration plan that will enable BLM staff to understand factors that influence erosion rates on serpentine barrens in order to reduce erosion, sediment transport, and restore vegetation buffers.

- Develop a natural resource research program to determine characteristics of the unique ecosystem that are important and what the management response will be to changes in these characteristics.

## *1.3 Natural Resource Inventory*

A comprehensive inventory of the natural resources of SBMRNA is necessary to understand what resources are present there and to effectively manage those resources. Natural resources of the SBMRNA that have had little to no inventory to date include lichen species, invertebrate species, and bat species.

### 1.3.1 Air

The SBMRNA is located within the North Central Coast air basin. Airborne chrysotile asbestos originating from the New Idria serpentine mass portion of the SBMRNA has the potential to adversely affect human health (EPA 2008). Chrysotile asbestos is classified as a hazardous air pollutant under the Clean Air Act Amendments of 1990.

### 1.3.2 Water

The SBMRNA includes four major perennial streams including San Carlos Creek, Clear Creek (headwaters), Sawmill Creek, and Cantua Creek (headwaters; Cañada Azul). The streams are important habitat for riparian zone plant and animal species of CCMA, some of which are rare and federally-listed. All four streams originate from the New Idria serpentine mass. Rocks and soils of the New Idria serpentine mass contain chrysotile asbestos as well as high concentrations of heavy metals including nickel, chromium, cobalt, and mercury (Dynamac Corporation 1998; EPA 2008). Streams of the SBMRNA may transport chrysotile asbestos and mercury in sediment loads, adversely impacting wildlife and humans. Clear Creek is classified as an impaired watershed due to high levels of mercury.

### 1.3.3 Geology and Soils

The SBMRNA includes the northeastern portion of New Idria serpentine mass and includes a flanking portion of the Franciscan formation (sedimentary rock). The geology of CCMA,

including the SBMRNA, has been mapped by Eckel and Meyers (1946), Coleman (1961), and Van Baalen (1995). The BLM has since mapped (2010 and 2011) serpentine masses (tectonic) and serpentine landslides in a high level of detail.

Large areas of the New Idria serpentine mass (particularly the barrens) are generally mapped as Henneke soil series and Igneous rock land in the San Benito county soil survey (Isgrig 1969). The USDA Natural Resource Conservation Service (NRCS) recently completed a detailed soil survey for the CCMA in San Benito county in 2011 to resolve soil series polygon mapping discrepancies across the San Benito - Fresno county line and to more accurately describe soils of the New Idria serpentine mass (Reinsch and Arroues 2010). The survey resulted in the description of five soil series derived from serpentine including Duckworth, Cascara, Flomack, Delmexico, and Idriapeak. Additionally two new soil series derived from nonserpentine (sedimentary) rock were described including Sancarlos and Borreguero.

### 1.3.4 Lichen Species

Lichens are present on rocks, shrubs, and trees within the SBMRNA. Globally, information about lichens present on serpentine rocks and soil is scarce. Some studies have found lichen species that appear to be unique or endemic to serpentine substrates (Sirois et al. 1988; Harris et al. 2007). A baseline lichen survey was conducted of serpentine and nonserpentine rocks in the CCMA in 2011 (Rajakaruna et al. in press). There were ten collection sites (5 serpentine, 5 nonserpentine) total distributed throughout the northern CCMA. Three collection localities were in close proximity to the SBMRNA: New Idria reservoir (serpentinite; immediately north of the SBMRNA), San Benito Mountain peak (serpentinite; within SBMRNA), and San Carlos peak (shale; immediately north of the SBMRNA). Of the 119 saxicolous lichen species collected, six including *Buellia aethalea*, *Buellia ocellata*, *Caloplaca oblongula*, *Rhizocarpon suarinum*, *Thelocarpon laureri*, and *Trapelia obtegens,* are reported new to California. Additionally, an apparently previously undescribed *Solenopsora* sp. is being genetically sequenced to confirm its taxonomic status. The rest of the species encountered are relatively frequent in the lichen flora of southern and central California, except *Aspicilia praecrenata*, a lichen considered to be extirpated from the South Coast Range. Although 60 of the lichen species sampled from the 10 collection suites were present only on serpentine rocks, it is unclear if any of the species may be regarded as unique or endemic to serpentine. Further studies (more extensive collection throughout the CCMA and other nearby serpentine areas) are needed to determine if any serpentine endemic lichen species are present.

### 1.3.5 Plant Species and Habitats

The diversity of rare vascular plants is one of the most remarkable features of the CCMA. Rare plant species that are known to occur or may occur within the SBMRNA include the federally-listed threatened San Benito evening primrose (*Camissonia benitensis*); CNPS list 1B rayless layia (*Layia discoidea*), talus fritillary (*Fritillaria falcata*), San Benito fritillary (*Fritillaria viridea*), Mariposa cryptantha (*Cryptantha mariposae*), Mt. Diablo phacelia (*Phacelia phacelioides*); and CNPS list 4 Guirado's goldenrod (*Solidago guiradonis*), serpentine leptosiphon (*Leptosiphon ambiguus*), San Benito monardella (*Monardella antonina* ssp. *benitensis*), Hernandez bluecurls (*Trichostemma rubisepalum*), Andrew's bedstraw (*Galium*

*andrewsii* ssp. *gatense*), Brewer's blarkia (*Clarkia breweri*), sulphur flower buckwheat (*Eriogonum umbellatum* var. *bahiiforme*), one-sided monkeyflower (*Mimulus fremontii*), and Santa Clara thorn mint (*Acanthomintha lanceolata*).

Inventories of plant species in the SBMRNA will serve as a baseline for GIS analyses describing the ranges of habitat characteristics in which rare plants currently exist, previously existed, or might exist under BLM management. These inventories will also serve as a baseline for tracking and mapping non-native invasive plants of concern to the BLM and to the California Department of Agriculture.

Existing information sources from herbarium holdings, expert knowledge, and inventory results will describe:

- historically known sites
- historically known sites outside the CCMA, but useful to define critical habitat features inside the CCMA
- delineation of first approximations of suitable habitat for each rare species
- plant searches for suitable and occupied habitats
- refinement of criteria used to delineate suitable and occupied habitats
- identification of habitat locations that have a high probability to sustain populations without directed BLM management or with species-specific directed management.

## 1.3.6 Vegetation

Detailed vegetation classification and mapping has been completed for the SBMRNA and the entire CCMA (Evans et al. 2006).

#### 1.3.6.1 San Benito Mountain Mixed Conifer Forest

Currently, the USDA Forest Service, Pacific Northwest Research Station Forest Inventory and Analysis (FI&A) Program has permanent plots, systematically selected throughout the Pacific Coast States. To understand changes in the San Benito Mountain mixed conifer forest, the BLM may review data collected over the span of several decades by the Forest Service.

Small isolated populations of conifer tree species in the Central California Coast Region are important globally as genetic resources. Jeffrey pine, Coulter pine, and incense cedar from San Benito Mountain resemble island-like distributions analogous to that of Monterey pine in the Central Coast Region. As such, they resemble unique genetic sources. Ledig (2000) has found that the unique hybrids between Coulter pine and Jeffrey pine from San Benito Mountain, first described by Zobel (1951a, 1951b), may have altered the genetic structure of Coulter pines through introgression.

## 1.3.7 Invertebrate Species

Little information exists about the diversity or uniqueness of arthropod species present on serpentine soils or in streams within the SBMRNA and the entire CCMA. Serpentine endemic

insect species have been found at several serpentine areas in California (Harrison and Shapiro 1988; Gervais and Shapiro 1999; Schwartz and Wall 2001; Boyd 2009). The isolated San Benito Mountain mixed conifer forest within the New Idria serpentine mass represents a forest island within a geologic island, providing conditions conducive to specialized adaptation and speciation.

### 1.3.8 Vertebrate Species

*Amphibians and Reptiles*

Perennial creeks including San Carlos Creek, Clear Creek, and Sawmill Creek are known to harbor BLM sensitive foothill yellow-legged frog (*Rana boylii*) and two-striped garter snake (*Thamnophis hammondii*). Uplands in the SBMRNA are habitat for California horned lizard (*Phrynosoma blainvillii*).

*Birds*

San Benito Mountain is an important migratory stop for many rare and infrequently seen bird species. The high elevation San Benito Mountain mixed conifer forest provides habitat islands for several bird species found nowhere else in the Central Coast Range (Johnson and Cicero 1985). Rare migratory birds that stop at San Benito Mountain include olive-sided flycatcher (*Contopus cooperi*), loggerhead shrike (*Lanis ludovicianus*), yellow-breasted chat (*Ichteria virens*), and grasshopper sparrow (*Ammodramus savannarum*). Other uncommon bird species include mountain quail (*Oreortyx pictus*), gray flycatcher (*Empidonax wrightii*), Hammond's flycatcher (*E. hammondii*), California thrasher (*Toxostoma redivivum*), rufous-crowned sparrow (*Aimophila ruficeps*), Bell's sage sparrow (*Amphispiza belli* spp. *belli*), and black-chinned sparrow (*Spizella atrogularis*).

*Mammals*

Presently, no data are available about bats resident in the SBMRNA or in the rest of the CCMA. BLM lands elsewhere in California with a history of mining have frequently become important habitats for bats. Abandoned mines host bats, mostly as single-species colonies, and perhaps only seasonally as maternity dens, migration rest stops, hibernation sites, and colonial roosts during the day. Many bat species are BLM California species of management concern. BLM sensitive bats that may be present within the SBMRNA include western mastiff-bat (*Eumops perotis californicus*), Townsend's western big-eared bat (*Corynorhinus townsendi townsendi*), pallid bat (*Antrozus pallidus*), Yuma myotis (*Myotis yumanensis*), long-eared myotis (*Myotis evotis*), fringed myotis (*Myotis thysanoides),* and small-footed myotis (*Myotis ciliolabrum*).

## *1.4 Natural Resource Monitoring*

Natural resource monitoring is essential to determine how ecological processes and species change over time. Monitoring results can be used to interpret effects of human activities.

### 1.4.1 Air

Wind erosion and aerial suspension of chrysotile asbestos presents a human health risk. Sampling and modeling of human health risk for asbestos under natural conditions has been conducted at the CCMA by research groups and the EPA (PTI Environmental Services 1992; EPA 2008). The BLM has an ongoing air sampling program for monitoring human exposure to chrysotile asbestos at the CCMA. BLM employees are required to conduct air monitoring for personal exposure to chrysotile asbestos whenever they work within the Serpentine ACEC (New Idria serpentine mass). Some air monitoring samples are collected within the SBMRNA.

### 1.4.2 Water

Serpentine rocks and soils of the SBMRNA and CCMA contain high concentrations of heavy metals including nickel, chromium, cobalt, and mercury (Kruckeberg 1984; Alexander et al. 2007; Arroues 2006; Reinsch and Arroues 2010). Clear Creek is classified as an impaired watershed due to high levels of mercury. Trends in heavy metal cycling in aquatic ecosystems are important to the overall health of the ecosystem. Concentrations of heavy metals often display a seasonal pattern in watersheds. In order to manage watersheds to reduce environmental pollutants, it is important to know what environmental pollutants exist and what their concentrations and seasonal patterns are. The US Geological Survey monitors water from Clear Creek at a gauging station near Oak Flat Campground.

In addition to heavy metals, erosion and liquid-suspended transport of chrysotile asbestos to water sources also presents a human health risk. Water transport of asbestos to the California Aqueduct from the CCMA was detected in 1980 (EPA 1991). The asbestos was believed to have originated from the Atlas Mine and was transported by water in White Creek to Los Gatos Creek and finally into the aqueduct. The EPA responded with remediation of the Atlas Mine in order to prevent further introduction of asbestos into the aqueduct. Large quantities of chrysotile asbestos are transported by water out of CCMA into streams and rivers annually.

Water quality is best monitored by establishing permanent measurement (gauging) stations. Currently, there is no formal program by the BLM to monitor water flow, sediment load, or water quality of streams within the SBMRNA or elsewhere in the CCMA.

### 1.4.3 Geology and Soils

Organic matter accumulation is an important factor in serpentine soil development and fertility (Alexander et al. 2007). Pioneer plant species such as buckbrush (*Ceanothus cuneatus*), manzanita (*Arctostaphylos glauca, A. pungens*), and pines (*Pinus sabiniana, P. coulteri,* and *P. jeffreyi*) can establish on barren serpentine soils and produce large amounts of leaf litter which decomposes and becomes incorporated into the soil. Increases in soil organic matter improve soil conditions for the establishment of secondary plant species such as leather oak (*Quercus durata*), silktassel (*Garrya congdonii*), toyon (*Heteromeles arbutifolia*), and many grass and forb species to become established within the serpentine plant community.

Little is known about organic matter cycling and accumulation on the serpentine soils of the SBMRNA. An understanding of organic matter cycling is important in understanding how vegetation becomes established on serpentine soils. Organic matter accumulation is best monitored by establishing permanent study plots.

Soil erosion is of great concern to BLM managers due to the high proportion of natural serpentine barrens within the SBMRNA and CCMA. Implementing standardized hydrological monitoring for sediment flows and for water quality will provide objective and comparable measures of the success of ecosystem management in the SBMRNA to minimize sediment flows and erosion. Long-term monitoring results can provide watershed-scale models of water and sediment flow, as well as changes to stream channel morphology. Water and sediment flows and stream morphology are critical factors in the formation and degradation of rare plant habitat such as the stream terraces frequently occupied by San Benito evening primrose.

Soil erosion can be quantified in two ways including soil depth loss as measured by staff gauge grid established upon the area of interest, or collection (basin or silt fence) of the sediment eroded from a particular area, downhill of that area. Sediment collection is the easiest method. One easy way to measure soil erosion is to establish silt fences at key sites of overland erosion (Robichaud and Brown 2002).

Currently, there is no formal program by the BLM to monitor soil development or erosion within the SBMRNA or elsewhere in the CCMA.

### 1.4.4 Lichen Species

Lichens are a sensitive indicator of environmental pollutants. Lichen health can be measured by total cover on rock or woody plant surfaces. Lichen colony growth on surfaces can be tracked by measuring its diameter.

Currently, there is no formal program by the BLM to monitor lichen species within the SBMRNA or elsewhere in the CCMA.

### 1.4.5 Plant Species and Habitats

*Federally-listed plant species – San Benito evening primrose*

Federally-listed threatened San Benito evening primrose has been monitored by the BLM since 1979. Complete monitoring details for San Benito evening primrose can be found in the San Benito evening primrose (*Camissonia benitensis*) Compliance Monitoring and Adaptive Management Plan (Appendix IV) of the Clear Creek Management Area Resource Management Plan (2012). Monitoring includes plant counts and documentation of habitat condition. A monitoring report is submitted to the Ventura FWS annually.

San Benito evening primrose is currently monitored by the BLM within the SBMRNA and throughout the CCMA.

*Other rare plant species*

Rare CNPS List 1B species including rayless layia, talus fritillary, and San Benito fritillary are currently monitored within the SBMRNA and throughout the CCMA. Monitoring by the BLM includes plant counts and documentation of habitat condition.

### 1.4.6 Vegetation

Vegetation is casually monitored by the BLM within SBMRNA and throughout the CCMA to evaluate human impacts and prevent non-allowable human uses (logging/woodcutting; off route vehicle travel).

### 1.4.7 Invertebrate Species

Monitoring of any BLM sensitive invertebrate species populations discovered within SBMRNA and the CCMA may be conducted following inventory.

### 1.4.8 Vertebrate Species

*Amphibians and Reptiles*

Foothill yellow-legged frog (*Rana boylii*) is a BLM sensitive species. Although foothill yellow-legged frog is declining over its entire range, populations in Clear Creek Management Area appear to be self-sustaining. The BLM developed a monitoring protocol for foothill yellow-legged frog in 2001 and monitoring is conducted annually throughout the CCMA.

*Birds*

Populations of passerine birds in chaparral and forest are of particular concern because these habitats are increasingly rare and fragmented. The high-elevation San Benito Mountain mixed conifer forest provides habitat islands for several bird species found nowhere else in the Central Coast Range (Johnson and Cicero 1985). Changes in the populations of rare bird species that nest in the conifer forest may be an indicator that habitat conditions are changing.

Breeding bird surveys have been conducted annually by the BLM within the SBMRNA and the CCMA since 1995. Species monitored include olive-sided flycatcher (*Contopus cooperi*), loggerhead shrike (*Lanis ludovicianus*), yellow-breasted chat (*Ichteria virens*), grasshopper sparrow (*Ammodramus savannarum*), mountain quail (*Oreortyx pictus*), gray flycatcher (*Empidonax wrightii*), Hammond's flycatcher (*E. hammondii*), California thrasher (*Toxostoma redivivum*), rufous-crowned sparrow (*Aimophila ruficeps*), Bell's sage sparrow (*Amphispiza belli* spp. *belli*), and black-chinned sparrow (*Spizella atrogularis*).

*Mammals*

Monitoring of any BLM sensitive bat species populations discovered in the SBMRNA and the CCMA may be conducted following inventory.

## *1.5 Natural Resource Research*

Science supports sustainable resource management of the SBMRNA and CCMA, and provides the objective information upon which BLM managers make choices for the benefit of the public. The BLM does not presume to have sufficient funding to support research of all natural resource types within the SBMRNA. Researchers interested in studying natural resources of the SBMRNA come from diverse disciplines and interest groups and from diverse government agencies, research institutions, universities in California and other states, and in several instances, internationally. The following research topics of interest may be undertaken within the SBMRNA:

### 1.5.1 Air

- Effects of chrysotile asbestos on the health of BLM employees and recreation visitors
- Modeling air quality impacts under alternate management scenarios, with special reference to the transport of air-borne asbestos, mercury, nitrogen- and sulfur-based gases, and ozone

### 1.5.2 Water

- Influence of the extremely sheared (pulverized) New Idria serpentine mass on local hydrology. Curiously, Clear Creek maintains high flow rates year-round, even during drought years
- Heavy metal and chrysotile asbestos transport and cycling in local streams and rivers

### 1.5.3 Geology and Soils

- Mineralogy (rare/unique minerals), geology (ultramafic), and tectonics (New Idria thrust fault)
- Why are the serpentine barrens so barren? Explore factors including geology (pulverized, unstable geology), adverse soil characteristics, and interaction with vegetation and human land use
- Rate of soil formation and soil erosion under different vegetation types and subject to different types and levels of human activities
- Model soil erosion under alternate management scenarios, with reference to the frequency and severity of naturally occurring and human-facilitated erosion
- Organic matter accumulation and nutrient cycling

### 1.5.4 Lichen Species

- Lichen adaptations to adverse physical and chemical conditions imposed by serpentine substrates

### 1.5.5 Plant Species and Habitats

- Plant adaptations to adverse physical and chemical conditions imposed by serpentine soils including macronutrient deficiency (nitrogen, phosphorus, potassium, calcium); macronutrient toxicity (magnesium); micronutrient deficiency (molybdenum); micronutrient toxicity (nickel), and other heavy metal toxicity (cobalt, chromium, mercury)
- Recovery of rare and federally-listed plant species. Research topic focus including optimal habitat parameters (soil, vegetation), soil seed bank, seed germination, seedling survival, fecundity, breeding system and pollination, demography, animal interactions, competitive interactions, population introductions, human impacts, population viability analysis
- Invasion by non-native plant species - Ecosystem resistance and management response for control on serpentine and nonserpentine soils

### 1.5.6 Vegetation

- Comparison of vegetation type on serpentine and adjacent nonserpentine soils across the geologic boundary. Influence of soil characteristics
- Conifer seed collection and ex situ tree breeding
- Dendrochronology – demography, historic climate and fire history interpretation
- Packrat nest (midden; rock outcrops) and pollen core (Spanish Lake) sampling – historic climate interpretation
- Model the development of forest vegetation on San Benito Mountain and changes under different scenarios of climate change and local human impacts
- Reforestation practices to restore logged and burned forests on serpentine soils
- Revegetation of serpentine barrens and other drastically disturbed serpentine substrates such as asbestos mine tailings
- Human history and land use (pre- and post-European settlement)

### 1.5.7 Invertebrate Species

- Invertebrate adaptations to adverse physical and chemical conditions imposed by serpentine substrates
- Influence of heavy metals in streams on aquatic invertebrate species
- Influence of insects (bark beetles) on the Sam Benito Mountain mixed conifer forest

### 1.5.8 Vertebrate Species

- Influence of heavy metals in streams on aquatic vertebrate species
- Invasion by non-native animal species - Ecosystem resistance and management response for control on serpentine and nonserpentine soils

### 1.5.9 Partnerships

Funding for science at BLM to improve land management has not been a fiscal priority in the recent past. BLM cannot depend on internal funding to initiate or support many of the research topics. Without investment, tasks for inventories, monitoring protocols, and field research in the SBMRNA would proceed slowly.

The BLM Hollister Field Office staff, and especially its natural resource and recreation specialists, can contribute their time and other in-kind services to scientists and researchers who wish to conduct research. The Field Office staff can continue to foster a setting of engaged inquiry with scientists and researchers at the many government agencies and universities located in the counties that surround CCMA.

One important step to facilitating environmental studies in the CCMA has been assistance agreements and memoranda of understanding between the BLM California State Office and the University of California and California State University systems, established in 2003. At present, the BLM works with the California state natural resource agencies and other federal agencies to collaborate on joint watershed planning. The BLM also currently works with researchers from the University of California and California State University systems on studies of federally-listed plant species recovery, serpentine plant tolerance and evolution and serpentine barrens revegetation. Such efforts improve lines of communications between BLM employees and interested scientists from regulatory and research agencies and universities.
The following institutions listed below are active in research that is occurring directly in the CCMA or bearing directly on the management issues of the CCMA. The BLM commits itself to working to promote the research work of these institutions in the CCMA and to expanding the roster of institutions involved. By promoting science in the CCMA, BLM promotes improvement of its own management to remain responsive to social and environmental needs for sustainable and robust ecosystems.

*Educational Institutions*

University of California System: Berkeley, Davis, Santa Cruz, Merced
California State University System: San Francisco, San Jose, Stanislaus
Stanford University
University of Utah

*California State Agencies*

Department of Fish and Game
Department of Forestry and Fire Prevention
Department of Parks and Recreation, Off-Highway Vehicle Recreation Division
Department of Water Resources (Water Resources Board)

*US Federal Agencies*

Environmental Protection Agency
National Science Foundation
US Department of Agriculture, Forest Service, Pacific Northwest Research Station,

Forestry Inventory and Analysis Program
US Department of Agriculture, Forest Service, Pacific Southwest Research Station, Institute of Forest Genetics
US Department of Agriculture, Natural Resource Conservation Service
US Department of Energy
US Department of the Interior, Geological Survey, Western Ecological Studies Center

*Governmental Organizations Outside of the United States*

Canadian Geological Survey
*Non-Governmental Non-Profit Agencies*
California Native Plant Society
California Federation of Mineralogical Societies
PRBO Conservation Science

## *1.6 Fire Management*

Fire objectives will closely approximate the historical and natural fire regime. Any fire that occurs in the SBMRNA will be followed by monitoring until the area once again approximates its former condition.

### 1.6.1 Characteristics

This Fire Management Unit (FMU) ranges in elevation from 2000 to over 5000 feet. The highest peak in the FMU is San Benito Mountain at 5,241 feet. The FMU contains nonserpentine chaparral, serpentine barrens, serpentine chaparral, and mixed conifer forest. The FMU contains several rare plant species including San Benito evening primrose, rayless layia, talus fritillary, and San Benito fritillary.

### 1.6.2 Fire History

Fire history for the SBMRNA may be characterized as one of minimal to infrequent fires, as a result of low fuel loads on the low-productivity serpentine soils and barren landscape. Fire ignition is primarily caused by lightning, but the potential for fires caused by humans also exists. Serpentine and nonserpentine chaparral poses potential for extreme fire behavior. Fire use and prescribed fire have been used in the past to maintain and promote uneven-aged brush fields to natural conditions.

### 1.6.3 Fire Management Objectives

**1)** Manage the habitat for threatened and endangered plant and animal species to maintain viable populations in their natural ecosystems.

**2)** Promote natural conditions within SBMRNA plant communities.

**3)** Restore and maintain structure, species composition, and processes of native ecological communities and existing ecosystems.

**4)** Maintain air quality to meet or exceed applicable federal and state standards and regulations.

**5)** Use fire to restore and/or sustain ecosystem health based on sound scientific principles and information, balanced with other societal goals, including public health and safety, and air quality.

*Management Emphasis – T&E Plants and BLM Sensitive Plants:*

1) Protect and improve potential habitat for special status plant species and the San Benito Mountain mixed conifer forest.

2) Provide a mosaic of plant community seral stages.

3) Improve native plant community diversity and structure.

*Suppression Objectives:*

1) Natural fires should be allowed to burn if they meet fire objectives. Fire retardants and scarification for fire lines or breaks should be avoided. A resource advisor from the Hollister Field Office must be notified before any retardant drops are planned from aircraft.

2) Fire will be managed for the protection of sensitive resource values, including the San Benito Mountain mixed conifer forest.

3) Use existing roads and natural barriers as the preferred method for containment and control of wildfire in the FMU.

4) The Monterey Air Board must be notified when any earth disturbance activities occur to conform to the Air Toxic Control Measures (ATCM).

5) The potential for the BLM to inherit the wildfire after the first 24 hours of suppression may be possible if objectives are not being met in accordance with the RMP and FMP.

*Fire Use and Prescribed Fire Objectives:*

1) Prescribed fire may be used to sustain desired characteristics. Specific seasonal timing, patch size, yearly total and rotational time for chaparral type fuel is to be coordinated with resource personnel.

2) Fuels treatment may be considered as needed by a site-specific plan. Allow the use of prescribed fire to promote natural conditions.

3) Use prescribed fire, wildland fires, and mechanical and chemical treatments to protect and maintain rare, threatened, and endangered plants and habitat, prevent the spread of invasive plants, and benefit chaparral components important to wildlife.

4) Construct hand line and natural fuel breaks and control lines for firing only when necessary, to preserve natural fire regimes.

5) Protect and enhance the San Benito Mountain mixed conifer forest within the SBMRNA.

6) All local and state air quality objectives will be met prior to ignition of prescribed fires.

*Post Fire Rehabilitation and/or Restoration Objectives:*

1) Immediately initiate post-fire rehabilitation and restoration to stabilize rare, threatened, and/or endangered plant habitat.

2) Prevent soil erosion and flooding by constructing water bars and installing erosion control (straw bales, straw rolls) on fire lines and fuel breaks.

3) Reseed with a diversity of locally-collected native plant seed in appropriate sites for species, if needed.

4) Monitor for and control invasive plant species.

Fire Management Strategies:

1) Use of Appropriate Management Response (AMR) to manage all fires for management objectives and based on current conditions and fire location.
2) Prevent wildland fires from spreading to private land and the communication site on San Benito Mountain.
3) Use natural barriers for containment.
4) Restore and Rehabilitate fire suppression lines created during fire suppression efforts in a timely manner to prevent erosion and stabilize sensitive habitat.

Implement the full range of wildland fire fuels management practices, provided they will contribute to historical and natural fire patterns. BLM's appropriate management response will address areas where plant communities are at high risk due to current conditions or other ecological constraints. Appropriate management response strategies will address critical habitat for wildlife, T&E species, areas of soil instability, and preservation of cultural resources. Use appropriate management response to prevent wildland fires from spreading to private and other agency lands outside the SBMRNA. Once the decadal burn target of 300 acres has been reached from either planned or unplanned ignitions, a review of objectives and strategies will lead to new suppression criteria on all wildland fires.

The appropriate management response is to prevent wildland fires from spreading to private land and to the repeater tower on San Benito Mountain. Suppression is coordinated between BLM

and CDF. The FMU is within Local Responsibility Area where the State provides direct protection under contract with the agency. Due to the presence of naturally-occurring asbestos in the FMU, however, CDF will not enter the SBMRNA. Instead, CDF will assume a support function outside of the FMU, to prevent further spread of wildfire. If resources are needed for suppression within the FMU, local red carded firefighters with hazardous asbestos health and safety training and other required training can enter the asbestos area. Additional resources will also need the proper training if extended fire suppression is required. Aerial application and the use of natural barriers is the choice for containment within the FMU. This FMU has very limited accessibility by land.

*Wildfire for Resource Benefits*

Management of wildfire for resource benefit is a fire management option within this FMU. Allow wildlfire to burn to promote natural conditions is identified as a component of research conducted within the SBMRNA. Established natural barriers may be able to hold fire within certain areas, depending on time of year, fuel loading, weather, location, and firefighting resources on hand, and if safety concerns have been addressed and mitigated.

## *1.7 Allowable Uses*

Uses inconsistent with the preservation of the values for which the SBMRNA was designated will be discouraged. Recreation and access must conform to management actions identified in the Proposed RMP (i.e. Proposed Action) and be consistent with SBMRNA management objectives. Activities involving organized events or commercial activities will need written authorization.

**All uses will be in accordance with 43 CFR 8223.1**

1) No person shall use, occupy, construct, or maintain facilities in a research natural area except as permitted by law, other Federal regulations, or authorized under provisions of 43 CFR 8223.
2) No person shall use, occupy, construct, or maintain facilities in a manner inconsistent with the purpose of the research natural area.
3) Scientists and educators shall use the area in a manner that is non-destructive and consistent with the purpose of the research natural area.

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